# Weathering and Soil

## Physical Geology
## Chapter 5

# Weathering, Erosion, and Transportation

- **Rocks exposed at Earth's surface are *constantly changed* by water, air, temperature variations and other factors.**
- ***Weathering*** **destructive processes that change physical and chemical character of rocks at or near Earth's surface**
- ***Erosion*** **is physical picking up of rock particles by water, ice, or wind**
- ***Transportation*** **is the movement of eroded particles by water, ice, or wind**

# Weathering and Earth Systems

- ***Solar system***
  - Earth-style weathering (water, ice, wind) is nearly unique to our planet, at present. Small amounts of weathering (primarily by wind) still occur on Mars, and water erosion appears to have been important there in the distant past.

- ***Atmosphere***
  - Oxygen and carbon dioxide critical to chemical weathering
  - Water cycled through atmosphere is critical to chemical and mechanical weathering processes
  - Air in soils contributes to biological action that can produce chemical and mechanical weathering

# Weathering and Earth Systems

- ***Hydrosphere***
  - Water is necessary for *chemical weathering*
  - Oxygen dissolved in water *oxidizes iron* in rocks
  - Carbon dioxide dissolved in water creates *carbonic acid*
    - Primary cause of chemical weathering
  - Running water loosens and abrades particles
  - Glacial ice removes and abrades particles
  - ***Freeze/thaw cycling mechanically weathers***
- ***Biosphere***
  - Plant root growth widens cracks—root pry
  - Animal foot traffic and human activity mechanically weather
  - Decaying organic matter in soils produces acidic soil moisture

# Types of Weathering

## *Mechanical weathering*

- *Physical disintegration*
- **Frost action, pressure-release fracturing, plant growth, burrowing animals, salt wedging, thermal cycling**

## Chemical weathering

- Decomposition of rock from exposure to atmospheric gases

(oxygen, water vapor and carbon dioxide)

- New chemical compounds (minerals) form
- Rate increased by increased rock surface area

**Spherical weathering**

# Mechanical Weathering (5)

## 1.Frost action

- Mechanic effect of freezing (and expanding) water on rocks

## 2. Pressure release

- Removal of overlying rock allows expansion and fracturing

## 3. Plant growth

- Growing roots widen fractures

## 4.Burrowing animals

## 5. Thermal cycling

- Large temperature changes fracture rocks by repeated expansion and contraction

# Chemical Weathering

## 1.Oxidation

- Chemically active oxygen from atmosphere
- Iron oxides are common result
  - Soil and sedimentary rocks often stained with iron oxides

## 2.Acid dissolution

- Hydrogen cations replace others in minerals
- Carbonic acid from atmospheric $CO_2$ dissolved in water
- Sulfuric, hydrofluoric acids emitted by volcanic eruptions
- Some minerals, such as calcite, may be totally dissolved

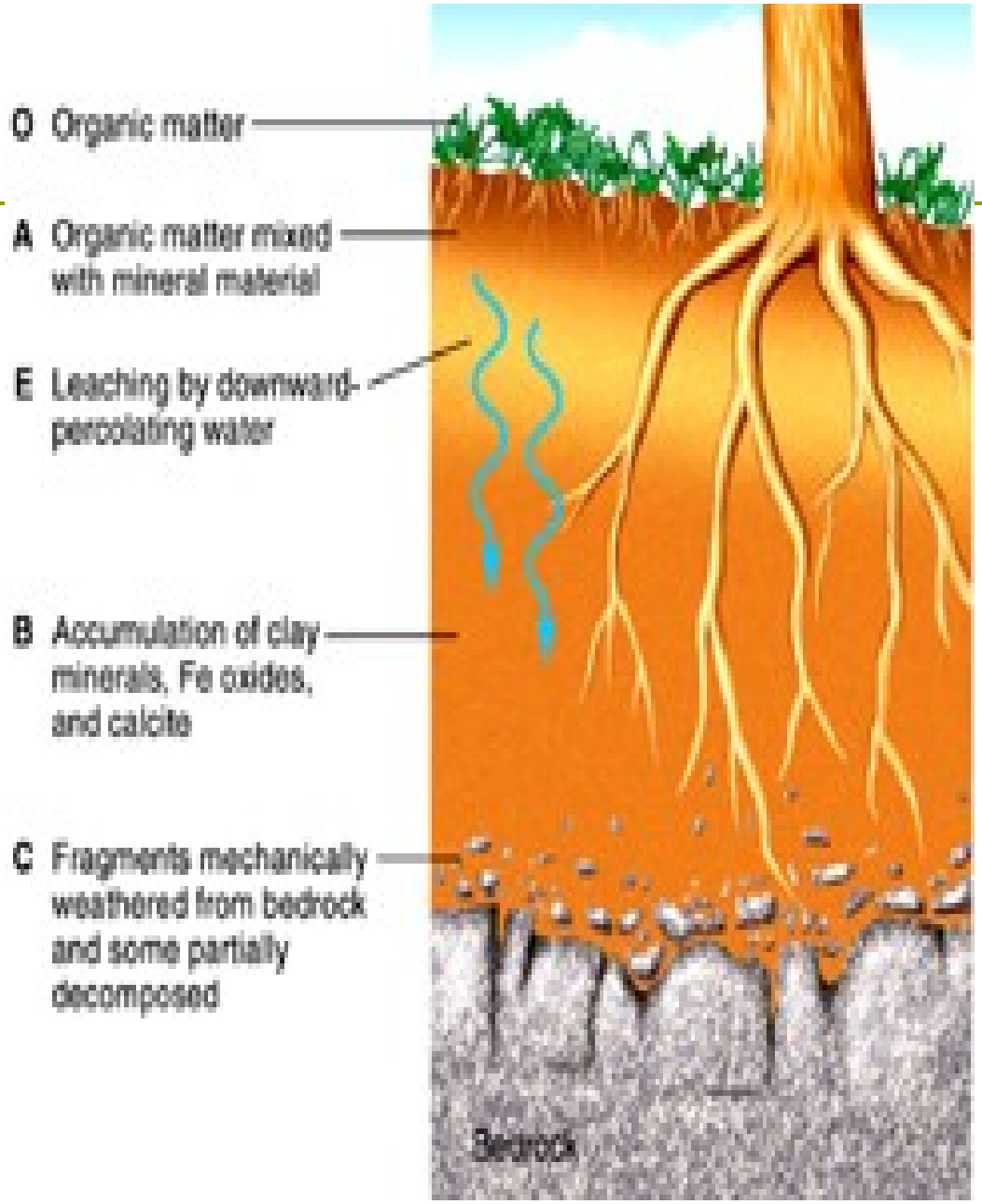
# Chemical Weathering Results

- ***Feldspars***
  - Most common minerals in crust
  - Slightly acidic rain water attacks feldspar
  - *Clay minerals* produced
    - $K^+$, $Na^+$, $Ca^{++}$ ions released into water
- ***Other minerals***
  - Ferromagnesian minerals
    - Clays, iron oxides, $Mg^{++}$ ions produced
  - More complex silicate bonds lead to lower weathering susceptibility
    - Olivine most susceptible, quartz least
- ***Warm, wet climatic conditions maximize weathering***

# Soil

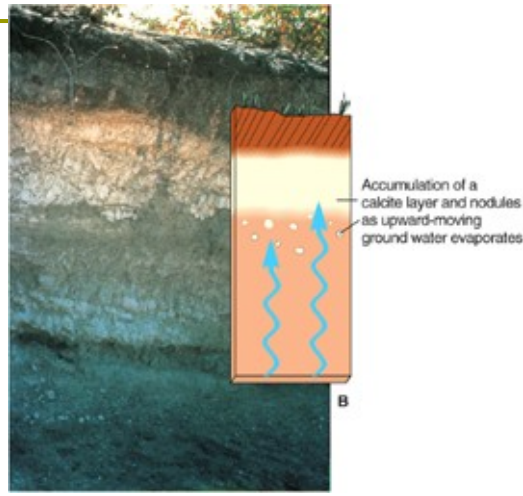
- ***Soil*** - a layer of weathered, unconsolidated material on top of bedrock
  - Common soil constituents:
    - ***Clay minerals***
    - ***Quartz***
    - ***Water***
    - ***Organic matter***

- ***Soil horizons** Know these!!***
  - ***O horizon*** - uppermost layer; organic material
  - ***A horizon*** - dark layer rich in ***humus***, organic acids
  - ***E horizon*** - zone of leaching; fine-grained components removed by percolating water
  - ***B horizon*** - zone of accumulation; clays and iron oxides leached down from above
  - ***C horizon*** - partially weathered bedrock


O Organic matter
A Organic matter mixed with mineral material
E Leaching by downward-percolating water
B Accumulation of clay minerals, Fe oxides, and calcite
C Fragments mechanically weathered from bedrock and some partially decomposed
Bedrock

# Soils and Climate

- Soil thickness and composition are greatly affected by climate
  - Wet climates:
    - More chemical weathering and thicker soils
    - Soils in moderately wet climates tend to have significant clay-rich layers, which may be solid enough to form a ***hardpan***
  - Arid climates:
    - Less chemical weathering and thinner soils
    - Subsurface evaporation leads to build-up of salts
    - Calcite-rich accumulation zones may form, cementing soil together into a ***hardpan***
  - Extremely wet climates (e.g., tropical rainforest)
    - Highly leached and unproductive soils (***laterites***)
    - Most nutrients come from thick O/A horizons




# Tables and Figures to study:

**Tables 5.1, 5.2, 5.3**Know the types of Soils**

**page 125 (13th ed.)**

**Figures: 5.13, 5.17, 5.23**

**Page 126 & 129!!!!!!!**